| N A S A |

U S L / D B M S N A S A / P C R & D

W O R K I N G P A P E R S E R I E S

Report Number

DBMS.NASA/PC R&D-11

The USL/DBMS NASA/PC R&D Working Paper Series contains a collection of formal and informal reports representing results of PC-based research and development activities being conducted by the Computer Science Department of the University of Southwestern Louisiana pursuant to the specifications of National Aeronautics and Space Administration Contract Number NASW-3846.

For more information, contact:

Wayne D. Dominick

Editor
USL/DBMS NASA/PC R&D Working Paper Series
Computer Science Department
University of Southwestern Louisiana
P. O. Box 44330
Lafayette, Louisiana 70504
(318) 231-6308

| WORKING PAPER SERIES |

(NASA-CR-184543) USL/DBMS NASA/PC R AND D PROJECT C PROGRAMMING STANDARDS Final Report, 1 Jul. 1985 - 31 Dec. 1987 (University of Southwestern Louisiana, Lafayette. Center for Advanced Computer

N89-14963

G3/82 Unclas 0183581

| N A S A |

USL/DBMS NASA/PC R&D PROJECT

"C" PROGRAMMING STANDARDS

Dennis R. Moreau

The University of Southwestern Louisiana
Computer Science Department
Lafayette, Louisiana

October 5, 1984

USL/DBMS NASA/PC R&D PROJECT "C" PROGRAMMING STANDARDS

This document establishes a set of programming standards intended to promote reliability, readability, and portability of "C" programs written for PC R&D development projects. These standards must be adhered to except where reasons for deviation are clearly identified and approved by the PC R&D team. Application for approval is made by completing the USL/DBMS NASA/PC R&D Form Number DBMS.NASA/PC FORM-1, "Request for Deviation from C Programming Standards," in Appendix A. Any approved deviation from these standards must also be clearly documented in the pertinent source code.

Two companion documents address other system development aspects, they are :

1) "NASA/PC R&D System Design Standards," USL/DBMS NASA/PC R&D Working Paper Series Report Number DBMS.NASA/PC R&D-12, October 12, 1984.

2) "NASA/PC R&D System Testing Standards," USL/DBMS NASA/RECON Working Paper Series Report Number DBMS.NASA/PC R&D-13, October 12, 1984.

Software systems and the procedures used to develop them must conform to the standards established in each of these

specification documents, as well as the standards contained within this document.

Many of the recommendations contained in this document were suggested in C Programming Guidelines by Dr. Thomas Plum (Plum Hall Publishing, 1984) and are used with the permission of the author. This book contains many enlightening examples and is highly recommended.

DATA AND VARIABLES

Variable names

Variable names should be in lower case and distinct within the first eight characters to assure portability. Longer variable names will improve readability. Declarations should be in alphabetical order within type and formatted so that names, types, and comments line up in vertical columns. Additionally, variable names should be meaningful and consistent throughout the program.

Constants

All program constants should be defined in either include files for constants relevant to multiple files or at the beginning of the source file for constants relevant to only

one program. Constant names should be capitalized and meaningful.

Machine Dependency

Programs should not depend on machine specific attributes such as byte order, word length, or implicit conversion for correct operation. Use only standard defined constructs and standard conversion functions.

CONTROL STATEMENTS

Control Structure

Each line that is part of the body of a "C" control structure should be indented eight character positions from the margin of the controlling line. This extends to function definition, structure declaration, and aggregate initializers.

Else-If

The "else-if" construct should be used in multiple choice situations whenever conditions are not mutually exclusive, when order of evaluation is important, or when multiple variables are tested. Otherwise a switch (case) statement

should be used.

Goto Statements

The "goto" statement should not be used since it degrades both reliability and readability. The while loop is appropriate to situations where "goto" functionality is desired.

FUNCTIONS AND MODULES

Function Format

An explanatory comment at the left margin is required before each function. Each parameter should have an associated comment describing it. Function definitions and external variable declarations also begin at the left margin.

Include Files

Include files unique to a project should be included using the syntax include "path" while standard include files should be included by include <path>. Path references are used only to facilitate compilation within a development directory. This will be changed with the next release of the operating system since it allows links. Include files should

not be nested and should be entered at the beginning of any source file. Include files should not contain initializations.

Source File Size

Source file size should be less than 500 lines since larger files are difficult to edit. Functions should be less than one page long (50 lines).

Scope Rules

Data should be local unless global referencing is necessary. Argument passing is preferred where data is only transferred to a function unless the data is being "passed through" for two or more levels.

Library Functions

Frequently used functions should have separate source files which should contain a short main program which can be conditionally compiled by setting a standard compile flag. This main program should execute a functional test of the library procedure. The compile flag name should reflect the name of the library procedure. Programs should interact with the environment through standard or library functions only and should assume nothing else about the environment.

Necessary environment dependencies should be isolated into small well documented functions.

Macros

Macros should be named in upper case and defined in the standard project include file. Replacement text should be parenthesized, as well as each parameter of the replacement text to prevent precedence difficulties.

Defined Types

Defined types should be written in upper case in order to recognize them as such in structure definitions.

GENERAL STANDARDS

Comments

A function which does a simple transformation on its arguments can be documented by a one-line header comment of the form "<verb> <objects>". Larger and more complicated functions should contain a description of major data structures and should describe the flow of control in a clear pseudo-code form. This is documentation in addition to the previously discussed parameter description. Any changes

should also be included and should reference a dated "change log" entry. Individual statements may need clarification and such comments should be included adjacent to the statement.

Specifications

A program must be clearly associated with an external specification document and there must be a makefile containing the names of all external source files necessary to the program.

Conformance Reviews

Programs produced for release must be reviewed by at least one person other than the programmer for conformance to these standards. A reviewer's concurrence means "I have read all of the associated code and its corresponding specification. It is understandable and conforms to its specification and to all applicable standards", and is signified by completion of USL/DBMS NASA/PC R&D Form Number DBMS.NASA/PC FORM-2, "Quality Assurance Conformance Review Report," in Appendix B.

This document is intended to help assure the mantainability and integrability of systems developed under the USL NASA/PC R&D project. Attention paid to these specifications from the

beginning of a design effort will be paid for many times over in saved debugging and maintenance effort.

APPENDIX A

DBMS.NASA/PC FORM-1

REQUEST FOR DEVIATION FROM "C" PROGRAMMING STANDARDS

Requestor: _____ Date: _____

Task Identification :

_____

Specific Program(s) or Module(s) Involved :

_____

_____

Nature of Requested Deviation :

_____

_____

Reason for Requesting Deviation:

_____

_____

_____

Recommendation:

_____

_____

APPENDIX B

DBMS.NASA/PC FORM-2

QUALITY ASSURANCE CONFORMANCE REVIEW REPORT

Reviewer: _____ Date: _____

Task Identification:

_____

Specification Document(s):

_____

Specific Program(s) or Module(s) Reviewed :

_____

Rate These Aspects (1=poor to 5=excellent) and Explain.

1) Conformance to Specification Document

_____

2) Conformance to Programming Standards

_____

3) Clarity of Code

_____

4) Documentation Completeness

_____

Additional Comments:

_____

Recommendation:

_____

5.11

1. Report No. IN	2. Government Accession No. 183581 ~~N87-14400~~	3. Recipient's Catalog No.

4. Title and Subtitle
USL/NGT-19-010-900: USL/DBMS NASA/PC R&D PROJECT 'C' PROGRAMMING STANDARDS
13P.

5. Report Date DATE
October 5, 1984 OVERRIDE

6. Performing Organization Code

7. Author(s)
DENNIS R. MOREAU

8. Performing Organization Report No.

10. Work Unit No.

9. Performing Organization Name and Address
University of Southwestern Louisiana
The Center for Advanced Computer Studies
P.O. Box 44330
Lafayette, LA 70504-4330

11. Contract or Grant No.
NGT-19-010-900

13. Type of Report and Period Covered
FINAL; 07/01/85 - 12/31/87

12. Sponsoring Agency Name and Address

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This Working Paper Series entry establishes a set of programming standards intended to promote reliability, readability, and portability of "C" programs written for PC R&D development projects. These standards must be adhered to except where reasons for deviation are clearly identified and approved by the PC R&D team. Application for approval is made by completing the USL/DBMS NASA/PC R&D Form Number DBMS.NASA/PC FORM-1, "Request for Deviation from C Programming Standards". Any approved deviation from these standards must also be clearly documented in the pertinent source code. Two companion Working Paper Series entries address other system development aspects: (1) "NASA/PC R&D System Design Standards," USL/DBMS NASA/PC R&D Working Paper Series Report Number DBMS.NASA/PC R&D-12, October 12, 1984; and (2) "NASA/PC R&D System Testing Standards," USL/DBMS NASA/RECON Working Paper Series Report Number DBMS.NASA/PC R&D-13, October 12, 1984.

This report represents one of the 72 attachment reports to the University of Southwestern Louisiana's Final Report on NASA Grant NGT-19-010-900. Accordingly, appropriate care should be taken in using this report out of the context of the full Final Report.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
C Programming Standards, PC-Based Research and Development	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	11	

*For sale by the National Technical Information Service, Springfield, Virginia 22161